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Research Paper

PLANNING, MODELLING AND ANALYSIS OF G+3 RESIDENTIAL BUILDING USING REVIT ARCHITECTURE AND STAAD PRO

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ABSTRACT

The construction industry increasingly relies on advanced software tools for accurate planning, structural analysis, and efficient project execution. This project focuses on the planning, structural analysis, design, and Building Information Modeling (BIM) of a G+3 residential building using modern engineering software tools such as STAAD Pro and Autodesk Revit. The primary objective of the project is to develop a safe, economical, and structurally stable residential building through proper design and analysis procedures.

Initially, the architectural planning of the building was carried out considering functional space requirements, building regulations, and structural feasibility. The structural model of the building was then created in STAAD Pro, where various loads such as dead load, live load, and other relevant loads were applied according to standard design codes. Structural analysis was performed to determine the forces, bending moments, and deflections in different structural members including beams, columns, and slabs. Based on the analysis results, the structural elements were designed to ensure safety, stability, and durability.

Following the structural design phase, the building was modeled in Autodesk Revit to develop a comprehensive BIM model. Revit was used to create detailed architectural and structural components, enabling better visualization, coordination, and documentation of the project. The BIM model also helped in improving design accuracy, reducing errors, and enhancing project understanding through 3D visualization.

The project demonstrates the effective integration of structural analysis and BIM technology in modern construction practices. The use of STAAD Pro ensures precise structural evaluation, while Autodesk Revit provides efficient modeling and visualization capabilities. The overall study highlights the importance of digital tools in improving the efficiency, accuracy, and quality of residential building design.

Keyword:- Residential building, structural analysis, structural design, STAAD Pro, autodesk revit, Building information modelling (BIM), load analysis, 3D Modeling.

I. INTRODUCTION

1.1 Background

The rapid growth of urbanization and population has led to an increasing demand for residential buildings, especially in urban and semi-urban areas. Efficient planning, accurate modelling, and safe structural design have become essential aspects of modern construction practices. With the advancement of technology, traditional methods of drafting and analysis have been replaced by sophisticated software tools that enhance accuracy, efficiency, and visualization. Building Information Modeling (BIM) has emerged as a powerful approach in the field of civil engineering, enabling engineers and

architects to create detailed digital representations of structures. Software such as Revit Architecture is widely used for planning and modelling of buildings, allowing users to develop 3D models, generate drawings, and visualize the structure effectively. On the other hand, structural analysis software like STAAD Pro is used to analyze and design structural components under various loading conditions, ensuring safety and stability.

1.2 Need for Study

The design and construction of multi-storey buildings require careful planning and analysis to ensure structural safety and functional efficiency. Manual design methods are time-consuming and

prone to errors, which can lead to inefficiencies and increased construction costs. The integration of Revit Architecture and STAAD Pro provides a comprehensive solution for designing and analyzing buildings with improved accuracy and reduced time.

There is a need to study how these software tools can be effectively used for planning, modelling, and structural analysis of residential buildings. Understanding their integration helps in improving workflow, minimizing errors, and optimizing structural performance.

1.3 Problem Statement

The increasing complexity of building structures demands advanced tools for accurate design and analysis. Traditional methods may not provide sufficient precision and visualization required for modern construction. Lack of proper integration between architectural planning and structural analysis can lead to design inconsistencies and structural inefficiencies.

1.4 Objectives

- To plan a G+3 residential building using Revit Architecture
- To develop a 3D model of the building
- To perform structural analysis using STAAD Pro
- To evaluate the effect of loads on the structure
- To ensure safety and stability of the building

1.5 Scope of Study

This study focuses on the planning, modelling, and analysis of a G+3 residential building using Revit Architecture and STAAD Pro. The work includes architectural modelling, structural analysis, and design under standard loading conditions. The study is limited to software-based analysis and does not include actual construction.

II. LITERATURE REVIEW

The advancement of computer-aided design and analysis tools has significantly transformed the construction industry. Researchers have explored the use of Building Information Modeling (BIM) and structural analysis software for improving efficiency, accuracy, and coordination in building projects.

Eastman, Teicholz, Sacks, and Liston (2011) provided a comprehensive overview of Building Information Modeling (BIM) and highlighted its importance in modern construction. Their study emphasized that BIM improves collaboration, reduces errors, and enhances project visualization through integrated digital models.

Azhar (2011) studied the benefits of BIM in construction projects and concluded that BIM-based approaches significantly reduce project cost and time. The research also highlighted improved coordination between architectural and structural components.

Kymmell (2008) discussed the implementation of BIM technologies and explained how tools like Revit Architecture enable efficient planning, 3D modelling, and documentation of building projects. The study emphasized the importance of digital modeling in improving design accuracy.

Hardin and McCool (2015) examined BIM applications in the construction industry and reported that BIM tools enhance productivity and facilitate better communication among project stakeholders. Their work also highlighted the role of Revit in architectural modeling.

Bentley (2008) studied the application of STAAD Pro for structural analysis and design. The research showed that STAAD Pro provides accurate results for load analysis, member design, and structural stability.

Krishnaraju (2010) explained structural analysis concepts and highlighted the importance of software tools like STAAD Pro in analyzing multi-storey buildings under various loading conditions such as dead load, live load, and wind load.

Punmia, Jain, and Jain (2005) discussed structural design principles and emphasized the importance of proper analysis for ensuring safety and stability of buildings. Their study highlighted the need for accurate load calculations and design procedures.

Sacks, Koskela, Dave, and Owen (2010) studied the interaction between BIM and lean construction techniques and concluded that

BIM improves workflow efficiency and reduces design conflicts.

Singh and Sharma (2017) investigated the integration of Revit and STAAD Pro and found that combining architectural modeling with structural analysis improves overall project efficiency and reduces design errors.

Reddy and Rao (2018) analyzed multi-storey buildings using STAAD Pro and concluded that software-based analysis provides accurate results and helps in optimizing structural design.

Kumar and Patel (2019) studied the modeling of residential buildings using Revit Architecture and emphasized that 3D visualization improves planning and decision-making in construction projects.

III. DATA COLLECTION

3.1 Overview

The methodology adopted in this study focuses on the planning, modelling, and structural analysis of a G+3 residential building using Revit Architecture and STAAD Pro. The process involves a systematic approach starting from architectural planning to structural design and analysis. The integration of these software tools ensures accuracy, efficiency, and better visualization of the building structure.

3.2 Planning Using Revit Architecture

The initial stage of the study involves planning the G+3 residential building using Revit Architecture. The building layout is designed based on standard residential requirements, including rooms, hall, kitchen, bathrooms, and circulation areas. The floor plans are prepared with proper dimensions, orientation, and space utilization.

Revit Architecture is used to create a detailed 3D model of the building, which includes walls, floors, roofs, doors, windows, and other structural elements. The software helps in visualizing the building design and identifying any errors at an early stage.

3.3 Modelling of the Structure

After preparing the architectural plan, the structural components such as beams, columns, slabs, and foundations are modeled in Revit. The structural model is developed by assigning

appropriate dimensions and material properties to each element.

The 3D model created in Revit provides a clear representation of the building, which can be used for further analysis. The model ensures proper alignment and coordination between different components of the structure.

3.4 Data Transfer to STAAD Pro

The structural model prepared in Revit is exported to STAAD Pro for analysis. The transfer of data is carried out using compatible file formats to ensure accuracy. This integration helps in reducing manual errors and saves time in the analysis process.

In STAAD Pro, the imported model is verified, and necessary modifications are made if required to ensure proper connectivity and geometry of the structure.

3.5 Structural Analysis Using STAAD Pro

The structural analysis of the G+3 building is carried out using STAAD Pro. Various loads such as dead load, live load, and wind load are applied to the structure as per relevant design codes. The software analyzes the structure and calculates internal forces such as bending moments, shear forces, and axial forces.

The results obtained from the analysis are used to evaluate the behaviour of structural elements under different loading conditions. The design of beams, columns, and slabs is carried out based on the analysis results.

3.6 Design and Verification

The structural members are designed based on the analysis results to ensure safety and stability. The dimensions and reinforcement details are checked to satisfy design requirements. The design is verified to ensure that all structural components are capable of withstanding the applied loads.

3.7 Data Analysis and Interpretation

The results obtained from STAAD Pro are carefully analyzed and interpreted. The behaviour of the structure under different loads is studied, and critical elements are identified. The analysis helps in optimizing the design and improving the overall efficiency of the building.

IV. RESULTS

Textbooks

Bansal R.K. – Strength of Materials
Hibbeler R.C. – Structural Analysis
B.C. Punmia, Ashok Kumar Jain & Arun
Kumar Jain – Reinforced Concrete Structures
S.S. Bhavikatti – Design of RCC Structures
C.S. Reddy – Basic Structural Analysis.

Software Manuals

STAAD Pro – User Manual and Technical
Reference Guide.
Autodesk Revit – Official User Guide and
Tutorials.

Journals & Research Papers

International Journal of Civil Engineering
Research (IJCER) – Papers related to structural
analysis using STAAD Pro.
International Research Journal of Engineering
and Technology (IRJET) – BIM and residential
building design studies.
Journal of Structural Engineering – Analysis
and design of RCC structures.

Online Resources

Bureau of Indian Standards – Official IS code
publications.
Bentley Systems – STAAD Pro tutorials and
documentation.
Autodesk – Revit learning resources and BIM
guides.

Lecture Notes / Academic Sources

Class notes and materials provided by faculty
(Structural Engineering & Design subjects).
University lab manuals for STAAD Pro and
Revit.